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## HISTORY OF THE MOAS.

BY F. W. HUTTON.

The Moas belong to a group of birds called Ratitæ, to which also belong the Ostrich, the Rhea, the Emu, the Cassowary, and the Kiwi. They are all birds with rudimentary wings, soft fluffy feathers and adapted for terrestrial life. Professor T. J. Parker has conclusively proved that the Ratitæ are descended from flying birds. The structure of their diminutive wings and the cellular character of their bones are evidence that the ancestors of the Ratitæ could fly, but these flying ancestors must have lived a very long time ago, probably in the early part of the eocene period. That the Moas have been a long time in New Zealand is certain. In addition to the immense number of bones found in peat beds and river-alluvia of pleistocene age, remains have been found near Napier and probably also near Wanganui, which belong to the newer pliocene period. The bones of a small species of Moa, found two years ago under a lava stream at Timaru, are still older and probably upper miocene, while the Hon. W. Mantell found in 1849 a fragment of a bone, which probably belonged to a Moa, near Moeraki in beds of lower miocene age.

The Ratitæ are generally supposed to have originated in the Northern Hemisphere, and to have spread southwards into Patagonia, South Africa, Australia and New Zealand. But if so, how could birds which could not fly manage to reach New

Zealand without being accompanied by any Mammalia? Certainly they did not precede the Mammalia, and it is very unlikely that they should twice have swum across straits which were impassable to mammals—once from the Oriental into the Australian region, and again from the Australian region into New Zealand—and there are other reasons for doubting the northern origin of the Australasian Ratitæ. The New Zealand Ratitæ are smaller than any of the others, and make a nearer approach to the original flying ancestors; and we should expect to find the smallest and least altered forms near the place of origin. Now there are in Central and South America a group of birds called Tinamous, which, although flying birds, have been shown by the late Professor W. K. Parker to resemble the Australasian Ratitæ in many particulars, and as the connection between South America and New Zealand is well known, it seems more probable that the Moas originated in New Zealand in the eocene period, from flying birds related to the Tinamous, and that they spread from here into Australia and New Guinea, than that they should have migrated southward from Asia.

In whatever way the Moas originated in New Zealand, it is evident that the land was a favorable one, for they multiplied enormously and spread from one end to the other. Not only was the number of individuals very large, but they belonged to no less than seven genera, containing twenty-five different species, a remarkable fact which is unparalleled in any other part of the world. Africa and Arabia are inhabited by but two or three species of ostrich; South America from Peru to Patagonia, has only three species of Rhea; Australia has two species of Emu and one Cassowary; while eight other species of Cassowary inhabit islands from New Britain to Ceram. Outside New Zealand two species of Ratitæ are rarely found living in the same district while a few hundred years ago there were in New Zealand several different kinds of Kiwi as well as the twenty-five species of Moas. An explanation of this problem may perhaps be found by examining the present distribution of the Cassowaries. Here we have eight species inhabiting five different islands, and if this region of the earth were to be

elevated, and the islands joined together, these eight species would mingle. If the region were to sink once more all of them would be driven to the highest land, and might all be crowded into one small island. Now we know, from geology, that New Zealand has gone through a series of changes in level, similar to those just mentioned. In the miocene period it consisted of a cluster of several islands, which were elevated and united in the older pliocene, and ultimately divided into the two islands we have now in the newer pliocene. If the ancestors of the Moas inhabited New Zealand during the eocene period they must have been separated on these islands during the whole of the miocene, and mingled together again in the pliocene. In this way—*i.e.*, by isolation—probably the genera originated, but the species appear to be due to variation without isolation. As is the case with most common animals, the Moas varied greatly and, there being no carnivorous mammals to hold them in check, while vegetable food was abundant, natural selection did not come into play, and the intermediate forms were not strictly eliminated. Under such favorable circumstances the conditions of life were easy, and the birds got larger and fatter, more sluggish and more stupid. The oldest known Moa is one of the smallest, and it is the smaller species which are found in both islands; from which we may infer that they were the only ones in existence when the two islands were united, and that the Moas since then increased in size. But the very large Moas were always comparatively rare. The commonest kinds in the North Islands were only from two and a half to four feet high, while those of the South Island were mostly from four to six feet in height. The giant forms, going up twelve and thirteen feet, were seldom seen.

Throughout the pliocene period the Moas flourished greatly; but in the pleistocene they must, in the South Island, have died in large numbers, for how else could such immense quantities of bones have come together in the peat-beds at Glenmark and at Hamilton in Central Otago. It has often been suggested that flocks of birds, attempting to escape from fires, rushed into the swamps and perished. But when we remember

that these Moas died thousand of years ago, long before there were any human inhabitants to light fires, it will be seen that this surmise is quite out of the question. Only two hypotheses appear to be possible to account for the facts. Either the birds walked into the swamp and were drowned or else their dead bodies were washed in. The first hypotheses is probably the explanation of the deposit at Te Aute near Napier, because many of the leg bones were found upright in their natural position. But at Glenmark and at Hamilton the bones were lying in all directions, as often upside down as in any other position, and the peat-beds were only a few feet thick, and filled with bones up to the very top. We cannot, therefore, suppose that these Moas were swamped, and there is evidence in both of these cases to show that the dead bodies of birds were washed in by floods. We find corroborative evidence of this in the alluvial plains of Central Otago, for these always contain numerous bones wherever a stream enters them from the hills.

But how are we to account for the number of dead birds washed down from the hills? There are two remarkable facts connected with these bone deposits at Hamilton and Glenmark. One is the very large proportion of bones of young birds from one-half to three-quarters grown; and the other is the absence of Moa egg shells. These two facts seem to show that the birds perished in the autumn or winter, when the birds of the year were not full grown, and when the females did not contain any hardened eggs. Also, it is evident that dead Moas could not be washed into swamps under the present climatic conditions, and the explanations of the puzzle must lie in the fact that in pleistocene times, when these bone deposits were formed, the climate was very different from what it is now. At that time the eccentricity of the earth's orbit was very great, and when winter in the Southern Hemisphere happened in aphelion, long cold winters were followed by short and very hot summers. It seems probable therefore, that the early winter snows killed large numbers of Moas and other birds on the hills, that their bodies were floated down by summer floods and avalanches caused by the melting snow,

and that they were deposited in hollows at the foot of the hills. As the pleistocene period passed away the climate became more equable and the surviving Moas once more increased and multiplied, until they were ultimately exterminated by the hand of man.

All are now agreed that the Moas were exterminated by the ancestors of the Maoris, and the only question upon which opinion is still divided is, How long ago was this? The case seems to me to stand thus. In the North Island there are several names of places in which the Moa is incorporated, but in the great number of Maori tales and poems which have been collected by Europeans the allusions to the bird are very slight and obscure, generally, indeed, fabulous. There is also one very ancient poem called "The Lament of Ikaherengatu." in which the phrase "Ka ngaro i te ngaro a tea Moa" (lost as the Moa is lost) occurs, which certainly shows that the bird was not in existence when the poem was composed. The so-called traditions of its habits appear to be, in large part at least, late deductions from these words and phrases, and we must conclude that in the North Island, the Moa was exterminated by the Maoris soon after their arrival in New Zealand; that is not less than 400 or 500 years ago.

In the South Island there are no names of places containing the word Moa, but here remains have been found—either skeletons lying on the surface or bones with skin and ligaments still attached—which give the impression that the birds were living here not more than ten or twelve years ago. Now the bones which are said to have strewn the surface so abundantly when the first settlers came, had all disappeared in fifteen years; so it is plain that either some change in the surrounding conditions cause the bones to decay, or that none of the bones which were so abundant in 1861, were more than fifteen years old. But as we cannot believe that Moas were abundant in Otago in 1846, we must fall back on the opinion that the fires lighted by the early settlers to clear the scrub so altered the conditions under which the bones had been preserved that they soon decayed, in which case we cannot say how long the bones may have been lying there. It is some-

thing the same with those bones which still have dried skin and ligaments attached. They are so fresh that, unless the birds lived a few years ago, they must have been preserved under specially favorable conditions; and there are reasons for thinking that the small district of Central Otago, in which alone these remains have been found, is one specially favorable for preserving animal remains. If this be so we cannot say for how many years they may have been preserved, perhaps for centuries, and as we have every reason to believe, upon the authority of the Rev. J. W. Stack, that the ancestors of the Ngai Tahu, who have inhabited the South Island for the last 200 or 250 years, never had any personal knowledge of the birds, we must allow that the Moa has been extinct for at least that time. On the other hand, it is quite certain that the Moa was exterminated by the Maoris, and the Maoris are not supposed to have inhabited the South Island for more than 500 years, so that the time of extinction must fall between these dates. It seems improbable that the Ngatimamoe, the last remnant of whom inhabited the West Coast sounds a few years ago, were Moa hunters. The moa hunters of the South Island were not cannibals, and as Te-rapu-wai and Waitaha, the tribes who preceded the Ngatimamoe, are said to have been peaceful and to have "covered the land like ants," it lends support to the Maori tradition that it was they who exterminated the Moa and made the shell heaps on the beach. If this be so the Moas were exterminated in the South Island about 300 or 400 years ago; that is, about a hundred years later than in the North Island.—*New Zealand Journal*.